Nutrient Bioavailability – Phytonutrients and Beyond

**Table 1: Nutrients/phytochemicals of interest and putative biomarkers for bioavailability & bioactivity endpoints**

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| **Nutrient** | **Biomarker for bioavailability** | **Molecules/Mechanism disturbed with deficiency** | **Chronic Disease impact** | **Biomarkers for chronic disease** |
| Calcium | Ca levels  Ca kinetics  Bone mineral turnover | PTH hormone levels  Loss of bone  microbiota | Osteoporosis | Bone density  MicroCT (bone architecture)  \* translational work in humans |
| Iron | Hemoglobin levels, Caco-2 model | Hemoglobin | NA | NA |
| Vitamin A | Vitamin A levels | Night vision  Immune function | NA | NA |
| Zinc | Zinc levels | Immune function  DNA integrity | Infection susceptibility  Inflammation  Cancer | Inflammatory markers/cytokines  Oxidative stress  DNA damage  \*studies done in cell culture, animals and translation work in humans |
| Vitamin D | Vitamin D3 levels | Ca homeostasis  Loss of bone | Osteoporosis | Bone density  MicroCT (bone architecture)  \* translational work in humans |
| Vitamin E | Vitamin E isomers & metabolite levels | Oxidative stress and Inflammation | Nonalcoholic Steatohepatitis  Cancer  Vascular Dysfunction | Oxidative stress  Inflammation markers  Fatty liver  Oxidative stress  \*studies done in animals and translational work in humans |
| Folate | C-14-folate & metabolites  Polymorphisms  Homocysteine  Methyl Pool  Plasma and RBC folate | Epigenetic alterations  Methylation changes  DNA damage | Cancer  Heart Disease  NTD  Anemia | Homocysteine accumulation  Methyl-pool alterations  DNA damage  Increased cancer risk  \*studies done in cells, animals and translational work in humans |
| B12 | B12 levels  TCII saturation  Methylmalonic acid | Epigenetic alterations  Methylation changes  DNA damage | Cancer  Heart Disease  Cognition  Anemia  Demyelination disease | Homocysteine accumulation  Methyl-pool alterations  DNA damage  Increased cancer risk  Memory tests  \*studies done in cells, animals and translational work in humans |
| Biotin | Biotin levels  Biotinylation of proteins  Urinary organic acids  Gene expression  Carboxylases | Epigenetic alterations  Genome instability  Altered cell differentiation | Cancer  Inflammation  Bone health  Obesity  Birth defects | Epigenetic changes  Aberrant gene expression  Abnormal urinary organic acids |
| Soy isoflavones | Isoflavone metabolite levels | Estrogen metabolism  Anti-inflammatory perturbations  microbiota | Bone health  Cancer  Heart Disease | Bone density  MicroCT (bone architecture)  Inflammatory markers  \*studies done in animals and translational work in humans |
| Green tea catechins | Catechin levels | Anti-inflammatory perturbations  Increased oxidative stress | Heart Disease  Nonalcoholic Steatohepatitis  Obesity  Cancer  Cognition | Inflammatory markers  Oxidative stress  Fatty liver  Cancer risk  \*studies done in animals and translational work in humans |
| Isothiocyanates | Isothiocyanate & metabolite levels | Epigenetic alterations  Altered detoxification  Oxidative stress  microbiota | Cancer | Epigenetic changes  Detoxification pathways  Cancer risk/incidence  Oxidative stress  \*studies done in cells, animals and translational work in humans |
| Quercetin | Levels of Quercetin and Methylated Metabolites | Inflammation, Oxidative Stress | Cardiovascular Disease, Hypertension | Pharmacokinetics  Nano-emulsion delivery systems |
| Anthocyanins | Levels of anthocyanins and metabolites | Inflammation, Oxidative Stress, insulin signaling pathways, adipocyte differentiation | Obesity  Inflammation  Cardiovascular disease  cancer | Inflammatory markers  Oxidative stress  Cardiovascular perturbations  Adipocyte growth/differentiation  Insulin resistance  Impaired glucose tolerance |

***Table 2: Active and Planned Collaborative Studies***

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| **Collaborative Studies** | **Related Proposal Objective** | **Participants** |
| Construction and testing of biokinetic models | 1.1., 1.2., 1.4., 2.4. | CA-D, CA-B, CT, IN |
| Analytical and separations chemistries | 1.1., 2.3. | CA-D, CA-B, CT, KS, MA |
| Development of novel technological approaches and their applications | 1.2.,1, 3, | CA-D, CA-B, CT, KS, OH, CO |
| Human and animal metabolic studies | 1.1., 1.2., 1.3., 1.4., 2, 4 | CA-D, CA-B, CO, CT, IL, KS, OH, OK, OR, |
| Epidemiological studies determining relationship among diet and bioactive food components and chronic disease risk | 2.1., 2.2., 2.4. | OR, CT, CA-D, CA-B, IN |
| Epigenetic mechanisms | 1.4., 2.2. | NE, OR, CA-B |
| Bioactive food components and cancer prevention | 2.1., 2.2., 2.3. | NE, OR, KS, CT, CA-B |
| Antioxidant, inflammatory and cell signal pathways as mechanisms for disease prevention | 2.3. | CO, OH, OK , OR, CT, IN, ME |
| Bioactive food components and bone health | 2.1., 2.4., | IL, IN, OK, |

***Table 3. Resources***

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| **Station** | **PI** | **Special Research Capability** |
| AZ | Teske, Jennifer | Animal models, body composition, behavioral measures of sleep, physical activity, energy expenditure, feeding, body composition, brain site-specific microinfusion, molecular biology, qPCR |
| CA-B | Shane, Barry | molecular biology, genomics, genetic variation, animal models, cellular and in vitro systems |
| CA-D  CO | Clifford, Andrew  Vanamala, Jairam | chemistry, isotope modeling, metabolomics, vitamins and phytonutrients, bioinformatics, human studies, LC/MS  Animal models, flavonoids, anthocyananin, food processing, oxidative stress, inflammation, bioavailability |
| CT | Bruno, Richard | Animal models, flavonoids, vitamin E vitamers and metabolites, oxidative stress, inflammation, human studies |
| IN | Weaver, Connie | Human and animal studies, calcium balance and kinetic modeling, bone turnover, bone densitometry, and bone micro-CT, bioavailability, mineral analysis, microbiota |
| KS | Lindshield, Brian | Molecular biology, diet-gene interactions, chemoprevention studies in cell culture, animal models, and humans, bioavailability, micronutrients |
| MA | Decker, Eric | Food composition, HPLC, GC-MS, LC-MS |
| NE | Zempleni, Janos | Biotinylation of proteins, epigenetics, chromatin, gene expression analysis, molecular biology, chromosomal damage, transgenic mouse models, protein/protein interactions |
| OH | Failla, Mark | Phytochemical bioavailability, inflammation, salivary and gut microbiota interactions, GI absorption modeling |
| OK | Stoecker, Barbara | Animal models, bone quality, zinc homeostasis, human studies |
| OK | Lucas, Edralin | Animal models, body composition, human studies, inflammation, cell culture, bone quality, oxidative stress |
| OR | Ho, Emily | Molecular biology, epigenetics, signal transduction, chemoprevention studies in cell culture, animal models, and humans; mineral metabolism and gene regulation (humans) |